Petrology of Late Cretaceous (ca. 90 Ma) lamprophyric dykes from north Greenland

D. J. Kontak, S. M. Jensen, J. Dostal, D. A. Archibald and K. Kyser

Mafic dykes cutting deformed lower Paleozoic sedimentary rocks of the Franklinian Basin have been sampled north of Frigg Fjord and Harebuk just off Frederick E. Hyde Fjord, northern Greenland. The dykes, forming the southern part of an extensive Cretaceous dyke swarm, can be related to a mantle plume that was responsible for extensive Cretaceous-Tertiary magmatism and basin formation in northern Greenland.

Normalized plot of most primitive dyke rocks.

The dykes (1-15 m wide, 10s-100s m long) outcrop as massive, fine-grained rocks with chilled margins and, in some cases, vesicular textures infilled with white to rusty brown carbonates. Py Dyke orientations vary from 135-155°/50-90°SW at Frigg Fjord to 060-080°/60-90°S at Harebuk Fjord. Petrographically the dykes are characterized by ophitic textures and are dominated by Opx-Pl-Imv-Ap±Ab±Bt±Kf, both Cpx and Pl are strongly zoned and Imv varies from euhedral to skeletal. A single dyke sample containing abundant granophyre surrounding zoned calcic plagioclase represents the most evolved composition. Alteration varies considerably (i.e., 0.05 to 6.6 wt.% CO₂) such that pristine to extensively altered material is represented; secondary minerals are Ms, Chl, Ab, Kf (Or₀₆₃ₒ₇), Fe-Mg-Mn carbonate, Fe oxides, iddingsite, Srp, Py. Mineral chemistry is as follows: Pl zoned from core (An₉₅₋₅₅) to rim (An₃₅₋₃₀) with ≤1.5 wt.% BaO, but An₂₀ in granophyres. Cpx is titaniferous augite with ≤4.1 wt.% TiO₂ and mg = 0.70±0.04 with substitution following Si → Ca+Al+Ti (r=0.98). Rare Opx has mg = 0.69±0.05 and is always corroded, whereas for Ol mg = 0.31 to 0.69 and single grains are strongly zoned (Feₒ₉₀₋₆₃). Bt has mg = 0.33 ± 0.03, is both F and Cl poor, and has 5 wt.% TiO₂. Major and trace element chemistry for least evolved samples (anhydrous, recalculated to 100%) are uniform at: (1) 45-47 wt.% SiO₂, 4.1 wt.% TiO₂, 15 wt.% Fe₂O₃(T), 2.8 wt.% Na₂O, 0.9 wt.% K₂O, 0.8 wt.% P₂O₅, and ≤0.03 and ≤0.08 wt.% Cl and F, respectively; (2) trace elements (ppm) are Rb=35, Sr=500, Ba=5500, Zr=220, Nb=28, Ni=45, Cr=75, Y=330; (3) REE are enriched (Laₑ₉₀=90, ∑14REE=175 ppm), strongly fractionated [(La/Lu)ₑ₉₀=7] and Eu/Eu*=0.96. Both major and trace element variations reflect crystal fractionation dominated by Cpx+Pl+Imv. Tectonic discriminant diagrams, based on both whole-rock and Cpx chemistry, and the LILE, HFSE and REE data are generally consistent with a within-plate setting, whereas OIB-normalized spidergram plots are close to unity (see Figure). Thus, both the chemical and mineralogical data are consistent with features of the lamprophyric association. ^⁴⁰Ar/^³⁹Ar dating of whole-rock material indicates an age of 90 ± 5 Ma for the magmatism.